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Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Alexander Menshchikov

PhD Program: Computational and Data Science and Engineering

Title of Thesis: Mathematical Modelling and Analysis of Intelligent Monitoring Platform for Precision Agriculture

Supervisor: Assistant Professor Andrey Somov

Name of the Reviewer: Oleg Sergiyenko

I confirm the absence of any conflict of interest:	Signature:
Yes, I confirm the absence of any conflict of interest	
(Alternatively, Reviewer can formulate a possible conflict) :	
No, there is no any conflict of interest	**Date: 08-09-2020**

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

- Brief evaluation of the thesis quality and overall structure of the dissertation.

The dissertation by Alexander Menshchikov, "Mathematical Modelling and Analysis of Intelligent Monitoring Platform for Precision Agriculture" is devoted to the development of various subsystems of a novel Unmanned Aerial Vehicle (UAV). It consists of two parts. The first part focuses on the development and analysis of Fully Convolutional Neural Network (FCNN) for plant image segmentation in the real-time. The second part is devoted to the mathematical modeling and experimental investigation of the Morphing Wing (MW) for the proposed UAV. The quality of the Thesis is significantly convincing, the related publications (JCR journals and conferences) properly covers the subject matter. The dissertation is well structured. The order of chapters is logic, and presents the information consistently. The results of mathematical modeling, analysis, experiments, and obtained results are cognitive and meaningful.

- The relevance of the topic of dissertation work to its actual content

The dissertation is relevant to its actual content in overall. It consists of two complementary studies: one is the computer vision and machine learning, another one is aeromechanics. This multidisciplinary investigation follows various aspects of aerial monitoring in agriculture nowadays. The first part reports the development of the computer vision algorithm for on-board low-power embedded systems with constrained computational capabilities. The second part reports the mathematical modeling and experiments on MW. Even though it is far from the computer vision area, it demonstrates how the MW reduces overall power consumption helping to increase the recourses available for on board computations. The author outlines these two aspects logically such that they complement to each other. The topic and the content, as well as main results of the Ph.D. thesis are showing the good coincidence.

- The relevance of the methods used in the dissertation

The author proposes the method for localization of the hogweed implying the data collection, network training, optimization for low-power embedded devices, and consistent testing both in the lab and in-situ. The methodologies behind the MW include mathematical modeling in the Computational Fluid Dynamics (CFD) software with a subsequent experimental investigation in the wind tunnel. All the above mentioned methodologies are relevant and match to the dissertation defined area.

- The scientific significance of the results obtained and their compliance with the international level and current state of the art

The results of the reviewed dissertation are both technically and theoretically sound; and comply with cutting-edge researches in the field of aerial imagery in precision agriculture currently reported in international literature. The data-intensive analytics in real-time is brought on board of the UAV by developing the optimized FCNN. The MW investigation opens new ways to reduce motor power consumption due to drag, an extension of the flight range, and controllability improvement under variable weather conditions. Both methods expand the capability of modern UAV platforms for smart agriculture: the first grants to reduce enough the overall time of post-processing of the aerial data; the second allows increasing the range of the monitoring. Therefore, the dissertation results have a significant impact in the area of UAV development for agricultural monitoring.

- The relevance of the obtained results to applications (if applicable)

Since Alexander in the dissertation initially focuses on developing the intellectual flying platform for monitoring of harmful plants, all the studies behind the thesis are directed to the proposed application. The results show a good relevance to the stated objectives, and can be useful for practical app.

- The quality of publications

To the best of my knowledge, Alexander has four journal publications as the first author. Three of them are in the Q1 journals with an impact factor greater than 2. Besides, he has publications in 3 conference proceedings. All of them are in the IEEExplore database of IEEE conferences indexed in Scopus. However, Alexander also participated in 5 more conferences with posters. Moreover, he also has one patent related to the area of computational fluid dynamics. The quality of all publications is no doubt; all of them are relevant to and coincides well with the topic of dissertation.

Provisional Recommendation

☒ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*

☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report*

☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*